A MARKET ANALYSIS OF TROUT FISHING ON THE FORT APACHE INDIAN RESERVATION

A Market Analysis of Trout Fishing on the Fort Apache Indian Reservation

David A. King, Professor

Ann W. Walka, Research Assistant

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Introduction

The native Arizona trout (Salmo apache Miller) is a threatened species. The natural distribution of the species is presently in the headwaters of the Black, White and Little Colorado Rivers of the Fort Apache Indian Reservation and Apache-Sitgreaves National Forest. Introductions of the fish have been made into streams on the Apache-Sitgreaves, Coronado, and Kaibab National Forests in Arizona (Rinne). Some of the best habitat for this species is found on the Fort Apache Indian Reservation.

A recovery team has developed a draft plan to recover the species from its threatened condition. The potential value of the species as a sport fish was recognized by the team, and research on the demand for sport fishing of the species is called for in the recovery plan.

The Problem

The White Mountain Apache Tribe manages its land and natural resources to achieve the economic objectives of employment and revenue and established the White Mountain Recreation Enterprise (it has since been renamed the Department of Natural Resources and Wildlife) to manage the recreational resources of the Reservation for these same objectives. Consequently, fee fishing, camping, and hunting are provided on the Reservation. A trout fishing success ratio that is higher than is available elsewhere in Arizona is a primary recreational attraction of the Reservation. The high success ratio is maintained through stocking of streams and of the lakes that have been constructed by the Tribe. A federal hatchery located on the Reservation provides the fish stock to the Tribe.

All persons 14 years of age or older must purchase a permit to fish on the Reservation. The fishing permits are issued either on a daily basis or annually. All waters believed to support populations of native trout have been closed to fishing by the Tribe. The Department of Natural Resources and Wildlife, however, is considering alternative means of opening the Arizona trout fishery to sport fishing under controlled conditions.

Camping is allowed only at designated areas, and at the time of the study, no areas had been designated for camping in the backcountry where the populations of the native trout are thought to be distributed. The camping fee was $2.50 per day per unit during the study period.

The two major dimensions of concern in the management of the Arizona trout fishery as a sport fishery are biological and human. Research on the biological dimension is being done by the RM-1710 project. These aspects include the specific location of populations, biological and habitat requirements, and the effects of fishing on the populations (Rinne). Knowledge about these aspects is basic to determining and evaluating habitat management alternatives and to fishing management questions regarding biologically acceptable or optimal fishing pressures and methods.

The human dimension includes the structure and nature of demand for sport fishing of the native trout fishery. From the standpoint of the recreation enterprise, a marketing study was needed to define and evaluate fishing management alternatives. Questions regarding fees, types of access, seasons, limits, and fishing methods needed to be answered to evaluate alternative modes of managing the fishing use of the fishery.

Finally, the two dimensions should be brought together in a total evaluation of alternatives in terms of costs and returns to the Tribe. Before that can be done, however, the basic boilogical and demand research must be done.

The purpose of this study was to initiate the measurement of the benefits, existing and potential, of the native Arizona trout fishery to the White Mountain Apache Tribe and to users of the fishery. Specifically, the study was concerned with the current and historical use of the Reservation sport fishery, identification of feasible fishing management alternatives, and estimation of current benefits from fishing on the Reservation.

Objectives

The specific objectives of this study were:

1. To identify and describe existing and potential trout fishing environments or sites on the Reservation to help define feasible fishing management alternatives and to provide a means for stratification of sites for demand estimation.
2. To define potential fishing management alternatives for the native Arizona trout fishery for the demand portion of the study.
3. To determine trends in trout fishing and estimate current benefits of the fishery to the White Mountain Apache Tribe.
4. To estimate the demand for trout fishing on the reservation.

Methods

Objectives one, two, and three were established primarily to facilitate the fourth objective, the estimation of the demand for trout fishing on the Reservation.

Identification of Trout Fishing Environments:

The basic purpose of this objective was to gain insights into the general nature of the Reservation fishing environments to be used in defining potential fishing management alternatives and to provide for potential stratification of existing sites for the demand portion of the study.

Personnel of the Natural Resources and Wildlife department were the primary source of information about fishing environments on the Reservation. Field reconnaissance was used to fill gaps in information.

A list of site attributes was developed with which to characterize fishing environments:

Lakes

- Surface area
- Shoreline length
- Auxiliary facilities
  - Boat rental
  - Tackle and biat
  - Cafe
  - Service station
  - Matel/cabins
  - Campground, number of units
  - Picnic area, number of units
- Access
  - Road type; paved, gravel, primitive
  - Distance form paved road by road type
- Stream characteristics

Width, depth, flow

Proportion of pools, riffles, smooth flow

Fish species

Streambank vegetation, predominant

Elevation

Most recent season success ratio

It became apparent very quickly that most of the attributes of the lakes and streams are highly correlated with elevation. Elevation, in turn, is highly correlated with accessibility in terms of travel time, distance and difficulty. Current fishing success ratios were not available. Thus, accessibility and the lake/stream dichotomy were the two site attributes used to differentiate site strata for the demand portion of the study.

Three strata were developed to be used in the demand analysis, one stream stratum and two lake strata. The strata and associated sites were:

Streams:

East Fork of White River

North Fork of White River
accessible from Upper Log Road
and Lower Log Road

North Fork of White River from
McCoy Bridge to Ditch Camps

Big Diamond Creek

Lakes:

Hawley Lake

Sunrise Lake

Horseshoe Cienega

Shush-Be-Tou

Shush-Be-Zazhe

Lower Bog Tank

A-1 Lake

Reservation Lake Group

Reservation Lake

Pacheta Lake

Drift Fence Lake

The low number of sample cases using Becker Creek, Pacheta Creek, Reservation Creek, Hurricane Lake and Cyclone Lake prevented inclusion of these sites in the demand analysis.

Definition of Potential Management Alternatives:

The management alternatives considered were limited to fishing management alternatives, not stream or lake habitat management alternatives. The alternatives were defined through discussion with the natural resources and wildlife managers. Six native trout alternatives were identified as being administratively feasible. The alternatives are displayed in Table 1.

Trends in Fishing and Current Benefits:

Cost data were not made available so no analysis of net revenue could be made. Data on fishing permit sales were available for only a few years so a time series demand analysis could not be done.

The number of fishing permits sold increased from 1960 to 1975. In 1976, a fee increase occurred and the number of permits sold decreased. However, total revenue from fishing permit and from camping permit sales increased. Assuming no shift in demand, that result indicated the demand for camping and fishing permits is inelastic. Another

Table 1. Fishing management alternatives for Arizona native trout on the Fort Apache Indian Reservation.

Alternative	Characteristics					
	Limit	Hooks	Access	Outfitting	Camping	Fee
A	Catch and Release	Barbless	Horseback	Horses, guides, food and tent	Yes	$150 for three days
B	Catch and Release	Barbless	Hike-in	None	Yes	$5 per day
C	Catch and Release	Barbless	Hike-in	None	No	$2.50 per day
D	10 native trout per day, 7" or longer	Barbed	Horseback	Horses, guides, food and tent	Yes	$175 for three days
E	10 native trout per day, 7" or longer	Barbed	Hike-in	None	Yes	$7.50 per day
F	10 native trout per day, 7" or longer	Barbed	Hike-in	None	No	$5.00

fee increase occurred for the 1978 calendar year. Permit sales data for 1978 have not been received so it has not been possible to determine whether the fee is still within the inelastic portion of the demand function. Based on the limited permit data available, it appeared that a fee of $3.50 per day would maximize total revenue from fishing permit sales.

Estimating Demand for Trout Fishing:

Since fishing for the native Arizona trout on the reservation is essentially prohibited, through the closure of streams and lakes in which the trout exist, the concern is with the potential demands for experiences. A two-phase approach was taken with regard to this part of the research.

The first phase was an attempt to identify the market segments to which native Arizona trout sport fishing, under various conditions, may appeal and to estimate the size of those market segments. Probably the largest source of potential native trout fishermen is the population of fishermen now utilizing the Reservation's sport fisheries. Other potential sources include those fishermen using the Tonto Creek drainage and Canyon Creek on the Tonto National Forest. These three groups probably are not mutually exclusive. In this study only the present users of the Reservation sport fishery were considered.

In the first phase an on-site survey of fishermen was conducted. A short interview was conducted to obtain information about length of trip, other activities engaged in while on the trip, fishing locations, place of overnight accomodation, and for a subset, the likelihood they would engage in one of the native Arizona trout fishing opportunities identified to fulfill objection. At the end

of the interview, the respondents were given a mailback questionnaire to complete and return after they returned to their homes.

Measuring the likelihood that a fisherman would participate in a hypothetical native trout fishing opportunity is equivalent to measuring an attitide. It has been found that the more specific the object of the attitude is to the individual's experience, the stronger is the correlation between the attitude expressed and subsequent behavior. Hence, the questions regarding the likelihood of participation were asked only of those fishermen who knew about the native Arizona trout and who fished primarily with artifical lures and flies. The latter restriction was imposed because bait fishing for native trout would not be allowed under any conditions. Further, the questions regarding potential participation were worded so as to refer to fishing sites, lakes or streams, best known to the respondents. This further restriction increased the specificity of the hypothetical situation to the respondent's experience and knowledge.

The budget made possible 30 on-site sampling days. Fishing sites were stratified geographically for sampling purposes. These strata were not the same as those identified for use in the demand analysis. The strata and sites within each were:

1. Becker Creek
2. Pacheta Creek, Reservation Creek, Hurricane Lake
3. East Fork of White River
4. Upper Log Road and Lower Log Road of North Fork of White River.

5. McCoy Bridge to Ditch Camp on North Fork of White River, Cyclone Lake
6. Diamond Creek
7. A-1, Lower Bog Tank, Shush-Be-Tou, Shush-Be-Zazhe, and Horseshoe Cienega Lake
8. Hawley Lake
9. Sunrise Lake
10. Pacheta, Reservation, and Drift Fence Lakes.

Allocation of sample days to strata was done as follows:

1. Five sample weeks were selected from the study period, May 27 through September 4, 1978. They were selected at random with the constraint that consecutive weeks would not be sampled.
2. A week was defined as running from Thursday through Tuesday, six days, of which two were weekend days and four were weekdays.
3. Each site was sampled once on a weekend day and twice on weekdays.
4. The weekend days in the five sample weeks were numbered consecutively starting with the first sample week, 1 through ten. Strata were randomly assigned to weekend days.
5. Week days were also numbered consecutively, 1 through 20. Strata were randomly assigned to days with the constraint that no stratum would be sampled on consecutive days.

The sample dates for each stratum were:

Strata	Dates
1	6/2, 7/13, 8/26*
2	6/24*, 6/26, 7/18
3	6/6, 7/15*, 8/24
4	6/5, 8/5*, 8/28
5	6/1, 8/4, 8/6*
6	6/3*, 6/22, 7/17
7	6/27, 8/7, 8/27*
8	7/16*, 8/3, 8/25
9	6/25*, 8/8, 8/29
10	6/4*, 6/23, 7/14

(*Weekend days)

Upon arriving at a site, the interviewer observed the fishermen that were present and assigned numbers to them. Then the required number of fishermen were selected using a table of random numbers. Shore and stream fishermen were approached directly for an immediate interview or an arrangement was made for an interview at a later time. Boat fishermen were met and interviewed at launching sites as they came off the lake.

The purpose of the mailback questionnaire was to measure variables that could be used, potentially, to identify market segments and to determine which, if any, market segments were specifically associated with high likelihoods of participation in native trout fishing opportunities. The variables measured included socioeconomic characteristics, such as age, income, education, population of place of residence, occupation and sex, and two sets of preferences. The first

preference set was made up of experience attributes or expected consequences of the experience. The scale items developed by Driver (1975) and others were used (Knopf, Driver, and Bassett 1973; and Hampton and Lackey 1975). The second set were preferences for resource attributes. Research by Brown, Driver and McConnell (1978) provided a list of scale items. These items were used, modified, and added to as deemed necessary to be applicable to the Reservation fishing situation.

To complete the market segmentation phase, data on fishing use patterns, socioeconomic characteristics, reservation experience, experience preferences, and resource attribute preferences were gathered in a mail survey of fishing permit purchasers during May through September, 1978. The fishing permit files provided the sampling frame.

Daily permits for each month were sampled as soon as they became available, and a series of five mail surveys was conducted to gather data for both the market segment phase and the estimation of demand for the fisheries now avialable on the Reservation. This approach reduced respondents' recall errors regarding the characteristics of their trips and their participations costs as compared to a single, post-season survey. It also made it possible to complete data coding and keypunching sooner than if a single survey had been conducted. A sampling rate of 1 percent of the daily permits was set. This rate resulted in a sample size of 500.

For both mail surveys, two weeks after initial distribution of the questionnaires, a postcard was sent to nonrespondents reminding them that their responses were necessary to the success of the survey. After another two-week period, a letter and another copy of the questionnaire was sent to nonrespondents. Similarily, a third mailing was made.

Since a user population was being sampled, a high response rate was expected. This expectation was not fulfilled. Response rates to the mail surveys are shown in Table 2.

In an attempt to account for nonresponse bias, a sample of 57 nonrespondents was drawn. A short telephone interview was developed to measure a subset of the variables included in the study and to ascertain the reason for their nonresponse. Characteristics of the response to the nonrespondent survey are shown below.

Completed interviews	22
Refusals	8
Not reached	3
Unpublished Numbers	5
No listing	14

Although complete interviews were obtained from only 22 of the 52 nonrespondents sampled, 26 did provide information on the number of fishing trips they took to the Reservation in 1977.

Cluster analysis of the preference data from both surveys (Tryon and Bailey 1970) to derive recreation experience and resource attribute item clusters and to develop a fishermen typology to be used in the demand analysis. The typology was used as a market segmentation device.

The second phase of the approach to accomplishing this objective was the estimation of the demand for the existing sport fishing on the Reservation. The important question for the recreational enterprise is the demand for new sites within the Reservation. Therefore, the appropriate model is a regional demand model using participation costs as surrogates for price (Clawson and Knetsch 1966; Dwyer, Kelly and Bowes 1976; Burt and Brewer 1971). The Reservation was the "region" in this study.

Table 2. Response to onsite mailback survey and mail surveys

On-Site Sample

On-Site Interviews	Usable Responses to Mailback	Rate of Response
112	88	79%

Mail Survey of Permit Sample

Month	Estimate of Population Size (# of permit)	Sample Size	Usable Questionnaire	Rate of Response (%)
May	8,900	89	59	66
June	12,200	122	74	61
July	13,300	133	72	54
August	9,200	92	62	67
Sept.	6,400	64	33	52
Totals	50,000	500	300	60%

This definition seemed reasonable since the higher success ratio on the Reservation might make these fishing experiences different from those in other areas of Arizona.

In applications of the regional model, either a system of demand equations has been estimated (Burt and Brewer1971), or a single equation has been estimated with site characteristics represented by an attractiveness variable (Cesario and Knetsch 1976). Since the former approach is more straightforward with regard to statistical estimation techniques, a modification of it was attempted. The modification was the use of participants rather than households in the general population of the Reservation's market area and not imposing symmetry restrictions on the cross-price coefficients.

Sites on the Reservation were stratified into areas on the basis of their resource attributes and geographical location as described above. An attempt was made to estimate demand equations for each strata. The hypothesis was that differences in price elasticities would be found among strata (Talhelm 1973). A more inelastic demand means a higher fee is possible, and higher unit management costs can be borne as compared to a more elastic demand.

The quantity variable was the number of trips per party. The variables tested for specification of the demand function included participation costs, income, socioeconomic characteristics, fishermen type, opportunity costs of time, and prices of substitutes. Ordinary least squares was used to estimate the equations.

RESULTS

Respondents vs. Nonrespondents

As stated above, a sample of 52 nonrespondents to the mail survey of permit purchasers was drawn to be interviewed by telephone. A very short questionnaire was used which included the following variables: number of fishing trips to the Reservation between May 1 and September 30, 1977; number of fishing trips taken to places not on the Reservation; years fished on the Reservation; years trout fishing; age; education; income; and marital status. Differences in means between respondents and nonrespondents were tested using the T test.[1]

Reasons for not responding: The nonrespondents that were contacted were also asked why they had not responded to the mail survey. These responses were categorized and are shown in Table 3. Almost a third of the sample of the nonrespondents contacted did not respond to the mail survey because they felt the questionnaire was too difficult or too long. Questionnaire complexity and length are frequently cited as reasons for nonresponse, and these results agree, 17 percent just didn't like surveys or felt the questions were too personal. There is no way to avoid this problem. Sixteen percent didn't respond because they didn't catch any fish, or didn't fish. This indicates that the letter of transmittal and the questionnaire could have been more appealing and more explicit.

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[1]This assumes that the responding nonrespondents were a random sample of the nonrespondent population of permit purchasers.

Table 3. Reasons for not responding to mail survey by respondents and nonrespondents to follow-up telephone survey.

Reasons	Respondents percent	Nonrespondents percent
Doesn't remember survey	10	
Lost in mail	3	
Questions don't apply	3	
Too hard, too long, too much time, didn't get around to it	30	
Didn't get one	3	
Wrong questions	3	
Forgot	3	
Fed up with Reservation	3	
Didn't catch any fish	3	
Don't do that much fishing	3	
Too personal		3
Don't like surveys		13
Claimed no permit, no questionnaire		7
Didn't fish on trip		3
No reply	3	—
Total*	67	26

n=30

*Does not sum to 100 because of rounding.

Number of fishing trips: Information on number of fishing trips to the Reservation was obtained from 26 of the nonrespondents. The mean for these fishermen was 1.23 as compared to 3.41 for the respondents to the mail survey. A one-tailed T test showed the nonrespondents' mean trips per season to be less than that of the respondents at the 1 percent level of significance. This result bears out the generally held hypothesis that those who are more active participants are more likely to respond to recreation surveys than those who are less active participants. The estimate of number of trips based on the mail survey was adjusted downward assuming the mean of 1.23 applied to all nonrespondents to the mail survey.

No significant difference was found with regard to total trout fishing trips taken off the Reservation.

Number of Fishermen: It must be noted that permits were sampled. A permit represents a trip, a fisherman, and a party, but only the trip is necessarily unique since more than one permit could be purchased by an individual during the study period. Hence, the permit sampling frame is a frame of trips, i.e. the population of trips was sampled. It follows that the number of fishermen and number of parties is equal to or less than the number of permits sold. By dividing the number of trips per fisherman (permits per fisherman) into the number of permits sold (total number of trips to the Reservation) an estimate of the total number of fishermen is obtained. This estimate divided by the number of sample respondents gives the sample expansion factor for the number of fishermen.

Trips per fisherman were estimated for May 1 to September 30, 1977, so Tribal permit data for 1977 was used to calculate the expansion factor for number of fishermen

Permit totals by month were not available for 1977, but they were available for 1976. That data indicated that 87.5 percent of the permits were sold during the May 1 through September 30 period. This proportion

was applied to the total number of permits sold during the summer season.

Total permits sold in 1977 = 69,166
Estimate of trips per fisherman = 2.42
Estimate of number of fishermen, May 1-Sept. 30:

$$\frac{(.875)(69,166)}{2.42} = 25,000 \text{ fishermen}$$

Socioeconomic Variables: No significant difference was found between respondents and nonrespondents with regard to mean years of education, age, or income. A chi-square test showed no difference in marital status.

Fishing Experience: Nonrespondents to the mail survey had fished on the Reservation fewer years than the respondents. A one-tail T test showed the difference to be statistically signfiicant at the one percent level. No difference, however, was found in overall years of trout fishing. It could be that those fishermen in the sample who had utilized the Reservation longer felt more of an obligation to respond and/or had more interest in the management of the fishing resources.

Fishing Styles: No significant differences were found using a chi-square test, between respondents and nonrespondents with regard to the type of water fished most frequently and the types of rod and reel used most frequently.

Summary: The only difference found, of those investigated, between the respondents and nonrespondents to the mail survey was in the number of fishing trips taken to the Reservation and years of fishing on the Reservation. In each case, the nonrespondents frequented the Reservation fewer times in 1977 and for a fewer number of years prior to 1977 than the respondents.

Fishermen and Their Patterns of Use

Descriptive socioeconomic statistics are presented in Tables 4-8. The fishermen are generally middle class, urban residents. Men outnumber women, and over half have had more than a high school education.

A series of questions was asked to develop a picture of the fishermen's patterns of fishing use and preferences. This information is presented in Tables 9, 10, and 11. Lakes are preferred to streams by a majority of the fishermen, and the larger lakes, Hawley, Sunrise, Horseshoe Cienega, and Reservation, are the favorites of a majority of those fishermen who had a preference. The various segments of the North Fork of the White River are favored by a majority of those who had a preference.

Styles of fishing are presented in Table 12. A majority of the fishermen use bait and the spincasting technique.

The fishing experience characteristics of the fishermen are presented in Table 13. Forty-nine percent of the fishermen were introduced to fishing before the age of 16 years. Almost a fifth of the fishermen were fishing on the Reservation for the first time. Those who were fishing on the Reservation for the first time were asked if they expected to return. Ninety-one percent did expect to return.

The general fishing experience of the fishermen is higher than their experience on the Reservation.

Trip characteristics are presented in Table 14. Three-fourths of the fishermen stayed overnight, and almost 60 percent of them camped on the Reservation. The average party size was just under four persons, and family parties were most prevalent, 81 percent. The average length of trip was slightly more than six days, and the average days fished was just under six. The difference represents travel time. The mean number of fishing trips to the Reservation in 1977 has been adjusted on the

basis of the results from the telephone interviews with nonrespondents. As stated above, the mean for respondents was 3.41 trips and for nonrespondents interviewed, it was 1.23 trips.

The number of days during which fishermen fished during their last trip to the Reservation, by site, are presented in Tables 15 and 16. The number of days fished per trip is generally slightly higher at stream sites than lake sites. Days fished per trip at all sites are less than days spent on the Reservation per trip. This result occurs because the same fishermen fish at more than one site during a trip and may not fish at all on some days during the trip.

The activities the fishermen engaged in are shown in Table 17.

Likely Participation in Native Arizona Trout Fishing

The on-site survey sample size was only 88 fishermen. Of these, only 23 (26%) were eligible to be asked the questions regarding the likelihood of their participation in the native trout fishing alternatives. Because any native trout fishing would be limited to the use of flies or other artificial lures, the screen for eligibility to respond to the question was whether or not the respondent fished most frequently with flies or artificial lures.

The respondents were asked to respond to the native trout fishing alternative in terms of the chance that they would participate, expressed in percentage. The results for the six alternatives are shown in Table 18.

Alternative A through C are the catch and release alternatives, and D through E allow the keeping of fish. Alternative A and D are fully outfitted alternatives with the highest fees. Camping is allowed in alternatives B and E and only day use in alternatives C and F. (See Table 1 for definition of alternatives).

Table 4. Age distribution of trout fishermen using the Fort Apache Indian Reservation, 1978.

Age	Percent
14 - 15	3
16 - 20	8
21 - 30	20
31 - 40	24
41 - 50	12
51 - 60	16
61 and older	18
Mean	42.2 years
$SE_{\bar{x}}$	.89
n*	376

*The on-site and permit sample combined. Sample size varies among variables due to nonresponse.

Table 5. Education distribution of trout fishermen using the Fort Apache Indian Reservation, 1978.

Education (Years)	Percent
0 - 8	3
9 - 11	12
12	31
13 - 15	28
16	10
More than 16	16
Mean	13.6 years
$SE_{\bar{x}}$	.15
n*	374

*The on-site and permit sample combined sample size varies among variables due to nonresponse.

Table 6. Income distribution of trout fishermen using the Fort Apache Indian Reservation, 1978.

Income $	Percent
0-9,999	11
10,000-14,999	17
15,000-19,999	15
20,000-24,999	25
30,000-39,999	6
40,000 and over	11
Mean	$23,431
$SE_{\bar{X}}$	835
n*	341

*The on-site and permit sample combined sample size varies among variables due to nonresponse.

Table 7. Marital status and sex of trout fishermen using the Fort Apache Indian Reservation, 1978.

Marital Status	Percent
Married	75
Single	25
Sex	
Male	74
Female	26

Table 8. Population of place of residence of trout fishermen using the Fort Apache Indian Reservation, 1978.

Place of Residence	Percent
Rural: less than 5,500	13
Semi-rural: 2,500-9,999	17
Semi-urban: 10,000-49,999	11
Small metropolitan: 50,000-149,999	10
Medium metropolitan: 150,000-499,999	18
Large metropolitan: 500,000 and over	31

Table 9. Preferences for and use of fishing waters by trout fishermen using the Fort Apache Indian Reservation, 1978.

Water Category	Preferred (percent)	Fished Most (percent)
Streams	38	28
Lakes	61	58
Both or no perference	1	14

Table 10. Favorite streams of those fishermen who had a preference, Fort Apache Indian Reservation, 1978.

Stream	Percent
Becker Creek	1
Reservation Creek	2
East Fork of White River	7
North Fork of White River (Upper and Lower Log Roads)	16
North Fork of White River (McCoy Bridge to Paradise)	7
North Fork of White River (Paradise to Ditch Camp)	28
Big Diamond Creek	13
Other	26

n = 105

Table 11. Favorite lakes of those fishermen who had a preference, Fort Apache Indian Reservation, 1978.

Lake	Percent
Hurricane	3
Cyclone	2
A-1	1
Lower Bog Tank	4
Shush-Be-Tou	3
Shush-Be-Zazhe	2
Horseshoe Cienega	11
Hawley	12
Sunrise	31
Pacheta	2
Reservation	23
Drift Fence	2
Other	3

n = 177

Table 12. Styles of fishing of trout fishermen using the Fort Apache Indian Reservation, 1978.

Lure Used Most Frequently	Percent
Bait	72
Artificial, not fly	14
Fly	14
n = 368*	
Type of Rod and Reel	
Spincast	62
Spin	22
Fly	16
n = 374*	

*The on-site and permit sample combined sample size varies among variables due to nonresponse.

Table 13. Fishing experience of trout fishermen using the Fort Apache Indian Reservation, 1978.

Age First Fished	Percent
less than 10	34
11 - 15	15
16 - 20	13
21 - 30	19
31 - 40	11
40 and older	8
Mean	20.0 years
$SE_{\bar{X}}$	.744
n*	356

Years	Years Fished (Percent)	Years Fished on Reservation (Percent)
1	6	19
2-5	15	28
6-10	19	21
11-15	14	14
16-20	14	9
21-30	19	9
31 or more	13	9
Mean	16.8	9.3 years
$SE_{\bar{X}}$	.661	.47
n*	355	362

*On-site and permit samples combined. Sample sizes differ among variables due to nonresponse.

Table 14. Fishing trip characteristics

Stayed Overnight	Percent
Yes	76
No	24
n = 384*	

Overnight Accomodation	Percent
Campground on reservation	59
Campground off reservation	7
Own summer home	6
Friends' or relatives' summer home	1
Friends' or relatives' permanent home	11
Motel	14
Other	2
n = 290*	

Type of Party	Percent
Alone	3
Family	59
Family and friends	21
Friends	16

Persons in Party $\bar{x} = 3.86$ $SE_{\bar{x}} = .119$

*On-site and permit samples combined. Sample sizes differ among variables due to nonresponse.

Table 14. Fishing trip characteristics (con't)

Days Fished/Trip	$\bar{x} = 5.8$	$SE_{\bar{x}} = .735$
Days Away From Home/Trip	$\bar{x} = 6.1$	$SE_{\bar{x}} = .493$
Trips per year	$\bar{x} = 2.42$	

Table 15. Stream sites fished and days fished per trip to the site Fort Apache Indian Reservation, 1978.

Site	Days Fished/Trip	$SE_{\bar{x}}$	n	Percent of Fishermen*
Becker Creek	-	-	0	-
Pacheta Creek	-	-	0	-
Reservation Creek	-	-	0	
East Fork White River	2	.357	11	3
North Fork White River				
Upper and Lower Log Road	4.5	.87	26	7
McCoy Bridge to Paradise	2.1	.50	17	4
Paradise to Ditch Camp	3.2	.44	44	12
Big Diamond Creek	3.1	.88	15	4

*The sum of the percentages is greater than 100 because some fishermen fished at more than one site on their trip.

Table 16. Lake sites fished and days fished per trip to the site, Fort Apache Indian Reservation, 1978.

Site	Days Fished/Per Trip	$SE_{\bar{x}}$	n	Percent of Fishermen*
Hurricane	1.3	.21	10	3
Cyclone	1.5	.29	4	1
A-1	1.6	.29	20	5
Lower Bog Tank	1.3	.09	32	8
Shush-Be-Tou	2.0	.26	21	6
Shush-Be-Zazhe	1.7	.36	16	4
Horseshoe Cienega	2.2	.22	54	14
Hawley	2.5	.39	53	14
Sunrise	2.5	.76	107	28
Pacheta	1.8	.72	11	8
Reservation	2.1	.18	65	17
Drift Fence	2.1	.33	13	3

*The sum of the percentages is greater than 100 because some fishermen fished at more than one site.

Table 17. Percent of fishermen engaging in various activities on the Fort Apache Indian Reservation, 1978.

Activity	Percent
Fishing	100
Camping	66
Picnicking	41
Photography	26
Nature Study	14
Hiking	28
Trail Biking	-
Other	4

The ranking of the alternatives by fee and average percent likelihood are:

	Rank by Likelihood	Rank by Fee
D	5.5	1
A	5.5	2
E	2	3
B	4	4
F	2	5
C	2	6

(Tied ranks are averaged.)

The rank correlation coefficient is -.67, which is signficant at the 1 percent level.

Another way to look at the potential of the alternatives is in terms of the number of respondents who said their "chances" of participating would be zero. The rankings on that basis compared to ranking on fees is:

	Rank by Frequency of Zero Probability	Rank by Fee
D	6	1
A	5	2
E	2.5	3
B	4	4
F	2.5	5
C	1	6

(Again, tied ranks are averaged.)

Based on this ranking of the alternatives, the rank correlation coefficient is -.87, which is, of course, significant at the 1 percent level.

Table 18. Likelihood of participation in native Arizona trout fishing Alternatives.

	Chance of Participation													
Alternatives	0	10%	20%	25%	30%	40%	50%	60%	70%	75%	80%	90%	100%	X(%)
A	18	2	1		1								1	7.4
B	12	1		1	1		6						2	24.5
C	10			1	2		5	1		1			3	33.5
D	19	1			1		1	1						6.5
E	11	1		1	1	1	2			1		2	3	33.0
F	11		1	2	1		4			2			3	32.6

It appears that the additional amenities of the higher cost alternatives do not overcome the negative influence of the higher costs.

At best, the data indicate that 15 percent of the present population of fishermen would respond positively to native trout fishing alternatives involving catch and release fishing, using barbless hooks, on a day use basis at a fee of $2.50 per day, alternative C. The fishermen who most frequently use flies or artificial lures comprise 28 percent of the fishermen population. They average 2.9 trips per year[2] and an average of 3.5 days per trip. The estimated number of such fishermen in the total population of fishermen is 7,000. Assuming that the percent chance they would participate in an alternative can be taken as their estimate of the percent of their fishing trips to the Reservation on which they would participate in an alternative, then an estimate of the number of trips and fishermen days for each alternative can be calculated using the following formulas.[3]

$$FT_i = P_i\ (7{,}000)(s.9)$$
$$FD_j = P_j\ (7{,}000)(2.9)(3.5)$$

Where:

FT_i = total fishing trips for alternatives A and D, which were specified to be three days long.

---

[2]The respondents to the mail survey who were primarily fly and lure fishermen had a mean of 4.17 trips per summer season. This figure was reduced by the same proportion, .7, as the mean for all types of fishermen as a result of the findings of the nonrespondent telephone interviews.

[3]Because of the low number of cases eligible to respond to the alternatives, no further analysis was done to further define the market segments to which they belonged.

7,000 = estimate of the number of fly and lure fishermen = (.28)(25,000)

2.9 = estimate of trips each summer

FD_j = total fishermen days for alternatives B, C, E, and F.

3.5 = average days fished per trip by lure and fly fishermen.

P_i or $_j$ = mean chance of participation (from last column of Table 18).

The relevant estimates of trips, days, and potential gross revenue as shown below:

Alternative	Trips	Fishermen Days	Potential Gross Revenue
A	1,502	4,506	$225,330
B	4,974	17,407	89,036
C	6,800	23,801	59,509
D	1,320	3,960	231,000
E	6,699	93,446	175,848
F	6,618	23,162	115,811

In 1977, the gross revenue from fishing permit sales was $265,179. The estimate of potential gross revenue from alternatives A and D approaches that figure. Days spent participating in any one of the alternatives are days that might be spent in other kinds of fishing on the Reservation for which regular daily permits would be purchased. Hence, the revenues are not additions to gross revenue. These are shown below:

Alternative	Additional Gross Revenue
A	$216,318
B	52,222
C	11,899
D	223,080
E	128,956
F	69,487

Each of the alternatives was responded to by the fishermen as mutually exclusive. For example, they responded to alternative B as if alternatives A, C, D, E, and F would not be available. Hence, the revenues of the alternatives cannot be summed, in part or for the whole.

Preferences for Psychological Outcomes and Environmental Features

Psychological Outcome Types: Based on the psychological outcome scales and the cluster analysis, 11 types of fishermen were identified, indicating the Reservation was providing 11 kinds of fishing experiences. These 11 types are based on five dimensions derived from the cluster analysis of associations among psychological variables. The five dimensions and the scales within them were:

Self-development	Reliability[4/]
Thinking about who you are	.8495
Gaining a sense of a self-confidence	
Thinking about your personal values	
Developing new skills and abilities	
Being away from family for a while	

[4] The reliability of a dimension measures the degree of internal consistency among scores on the individual items or scales clustered in the dimension. A reliability coefficient of .9 or larger is desirable. (Tryon and Bailey 1970).

	Reliability
Using skills and Equipment	.8315
Using your equipment	
Sharing your knowledge with others	
Applying your skills	
Talking to others about your equipment	
Rest and Relaxation	.7819
Giving your mind a rest	
Resting physically	
Relaxing or reducing some built-up tensions	
Relaxing physically	
Being with Friends	.7594
Doing things with your companions	
Being with members of your group	
Being with friends	
Natural Beauty	.7263
The scenic beauty	
Viewing the scenery	
Experiencing the peace and calm	

As explained in the methods section, the respondent's scores on each of these dimensions were used to cluster them into groups of psychological outcome types. Table 19 and Figure 1 show the mean scores of each O-type on each dimension or V-type.

We have not attempted to name the fishermen types partly because it is difficult and partly because the word descriptions chosen may carry different connotations for different readers. A narrative description of each of the types with regard to their scores on the five dimensions, however, is useful in untangling Table 19 and Figure 1.

Table 19: Mean scores of fishermen on psychological dimensions by fishermen/experience type

	Psychological Dimensions				
	1	2	3	4	5
Fishermen Types	Self-Development	Using Skills & Equipment	Rest and Relaxation	Being with Friends	Natural Beauty
1 n=33	Slightly Adds 5.91	Slightly Adds 6.13	Moderately Adds 6.60	Moderately Adds 6.56	Strongly Adds 7.53
2 n=22	Slightly Adds 5.56	Moderately Adds 6.58	Strongly Adds 7.80	Moderately Adds 7.33	Strongly Adds 8.24
3 n=31	Slightly Adds 6.12	Slightly Adds 5.73	Strongly Adds 7.90	Moderately Adds 7.12	Strongly Adds 8.41
4 n=21	Slightly Adds 6.23	Moderately Adds 7.02	Slightly Adds 6.08	Moderately Adds 7.44	Strongly Adds 8.09
5 n=26	Slightly Adds 6.31	Moderately Adds 6.83	Strongly Adds 7.53	Slightly Adds 6.23	Strongly Adds 8.35
6 n=25	Slightly Adds 6.31	Moderately Adds 6.97	Moderately Adds 7.11	Moderately Adds 7.29	Moderately Adds 7.10
7 n=41	Moderately Adds 6.52	Moderately Adds 6.60	Moderately Adds 7.33	Moderately Adds 7.29	Strongly Adds 8.21
8 n=28	Slightly Adds 6.23	Moderately Adds 6.97	Strongly Adds 8.13	Moderately Adds 7.32	Most Strongly Adds 8.68
9 n=25	Slightly Adds 6.42	Moderately Adds 7.32	Strongly Adds 7.66	Strongly Adds 7.85	Strongly Adds 8.04
10 n=36	Moderately Adds 7.22	Moderately Adds 7.02	Strongly Adds 8.10	Moderately Adds 7.47	Most Strongly Adds 8.54
11 n=31	Moderately Adds 7.27	Strongly Adds 7.82	Strongly Adds 8.33	Strongly Adds 7.93	Most Strongly Adds 8.70
Weighted Mean Scores	6.42	6.80	7.54	7.25	8.19
Rank by Weighted Mean Score	5	4	2	3	1

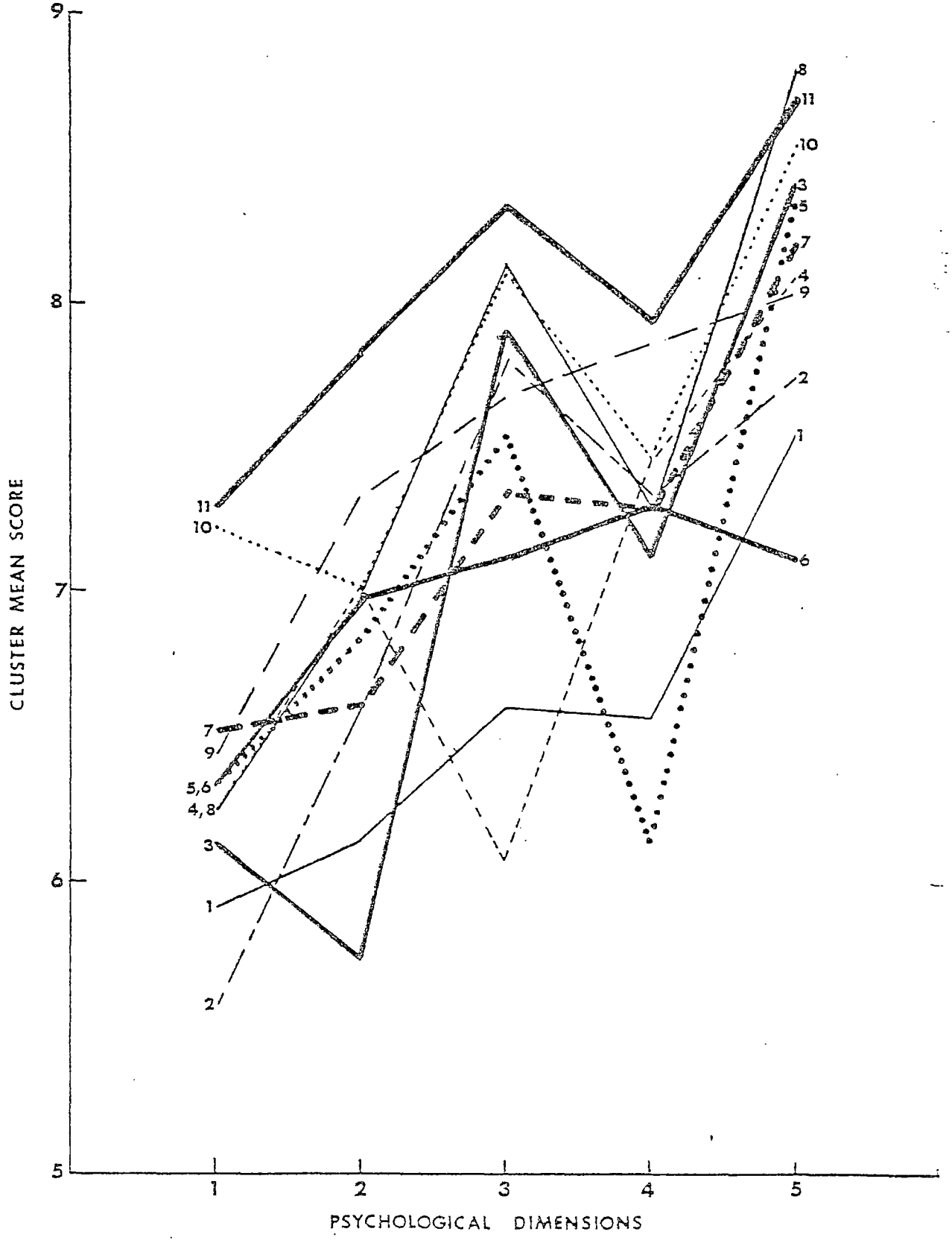

Figure 1. Mean scores of psychological outcome types on psychological dimensions.

All of the psychological dimensions add to the satisfaction of the fishermen. Each fishermen/experience type represents a different bundle of psychological outcomes in terms of the degree to which the dimensions add to satisfaction and hence, different fishing experiences (Driver and Brown 1978). Natural beauty adds most to satisfaction for all experience types except for type 6 for which it is second to being with friends.

Type 1--Natural beauty adds less satisfaction to this experience than it does to the other experiences. Self-development adds least to this experience. This type scores below average on all dimensions.

Type 2--Self-development not only adds least to this experience, fishermen in this type score lower on this dimension than all other types.

Type 3--Using skills and equipment adds least to this experience and less to this experience than any of the others.

Type 4--Rest and relaxation adds least to this experience, and less to this experience than to any of the others.

Type 5--Being with friends adds least to this experience, and less to this experience than to any of the others.

Type 6--Being with friends is the dimension that adds most to this experience and self-development least.

Types 7, 8, and 9--Self-development adds least to these experiences.

Type 11--All five dimensions add more to this experience than to any other experience.

Environmental Attribute Preferences: The environmental attribute responses were also analyzed using cluster analysis. The results of the variable cluster analysis were eight environmental dimensions. The dimensions and their scale items and reliabilities were:

	Reliability
Wildlife Presence	.9580
Presence of elk	
Presence of mule deer	
Presence of bear	
Presence of grouse	
Commercial Facilities	.9237
Bait shops at fishing sites	
Boat rentals at lakes	
Snack shops at fishing sites	
Motels at fishing sites	
Primitive Opportunities	.9058
Isolated, hike-in lakes	
Backcountry, hike-in streams	
Primitive campgrounds	
Dirt roads to fishing sites	
Developed Opportunities	.9012
Picnic tables	
Stream bank campsites	
Developed campgrounds	
Easily reached lakes	
Forests and Meadows	.8865
Dense stands of pine	
Aspen groves	
Alpine meadows	
Mature, virgin forests	
Man's Activities	.7945
Evidence of logging activity	
Insects that bite	
Evidence of mining activity	
Nature	.9068
Rare plants	
Unusually shaped rocks	
Scenic overlooks	
Song birds	
Fishing Enhancement	.9144
Marshes	
Streams with many fly hatches	
Streams lined with brush	

Cluster analysis of the responses of the fishermen to the environmental attribute scales produced five types of fishermen in terms of the eight environmental dimensions. These are shown in Table 20 and Figure 2.

The man's activities dimension, evidence of mining, evidence of logging, and biting insects, receives the lowest score from all five of the environment types. The forest and meadow dimension receives the highest scores from all of the environmental types. The weighted mean scores on the dimensions, Table 20, indicate that for the sample as a whole the dimensions rank, from high to low, as follows:

Forests and meadows
Nature
Wildlife presence
Developed opportunities
Primitive opportunities
Fishing enhancement
Commercial facilities
Man's activities

The results are in accord with the psychological outcome results in that they support the high scores given the natural beauty dimension.

The information in Table 20 may be summarized as follows:

Type 1--These fishermen are neutral towards commercial facilities and primitive opportunities and more positive towards developed opportunities than the sample as a whole.

Type 2--These fishermen score the commercial facilities dimension lower than the other fishermen and primitive opportunities higher. They also score wildlife and fishing enhancement higher than other fishermen. And they are the type that scores the forest and meadows dimension the highest.

Type 3--This group scores all dimensions, except man's activities, just slightly below the average for all types. They come closest to being the "average" group.

Table 20: Mean scores on environmental dimensions by environmental fisherman type

Environmental Types	Environmental Dimensions							
	1 Wildlife	2 Commercial	3 Primitive	4 Developed	5 Forests and Meadows	6 Man's Activities	7 Nature	8 Fishing
1 n=32	Slightly Adds 6.05	Neutral 5.30	Neutral 5.14	Moderately Adds 7.08	Strongly Adds 7.52	Slightly Detracts 3.64	Moderately Adds 6.80	Slightly Detracts 4.49
2 n=68	Moderately Adds 7.49	Moderately Detracts 3.47	Moderately Adds 7.50	Slightly Adds 5.88	Strongly Adds 8.10	Moderately Detracts 3.14	Moderately Adds 7.36	Moderately Adds 6.59
3 n=55	Moderately Adds 6.52	Slightly Detracts 4.43	Moderately Adds 6.61	Slightly Adds 6.37	Moderately Adds 7.18	Slightly Detracts 3.82	Moderately Adds 6.53	Neutral 5.50
4 n=55	Moderately Adds 7.03	Slightly Adds 5.83	Moderately Adds 6.54	Strongly Adds 7.93	Strongly Adds 8.08	Moderately Detracts 2.86	Moderately Adds 7.40	Neutral 4.75
5 n=40	Moderately Adds 7.18	Slightly Adds 6.07	Moderately Adds 6.73	Strongly Adds 7.71	Strongly Adds 8.01	Neutral 5.30	Moderately Adds 7.46	Slightly Adds 6.19
Weighted Mean	Moderately Adds 6.94	Neutral 4.85	Moderately Adds 6.67	Moderately Adds 6.89	Strongly Adds 7.80	Slightly Detracts 3.64	Moderately Adds 7.13	Slightly Adds 5.61
Rank by Weighted mean	3	7	5	4	1	8	2	6

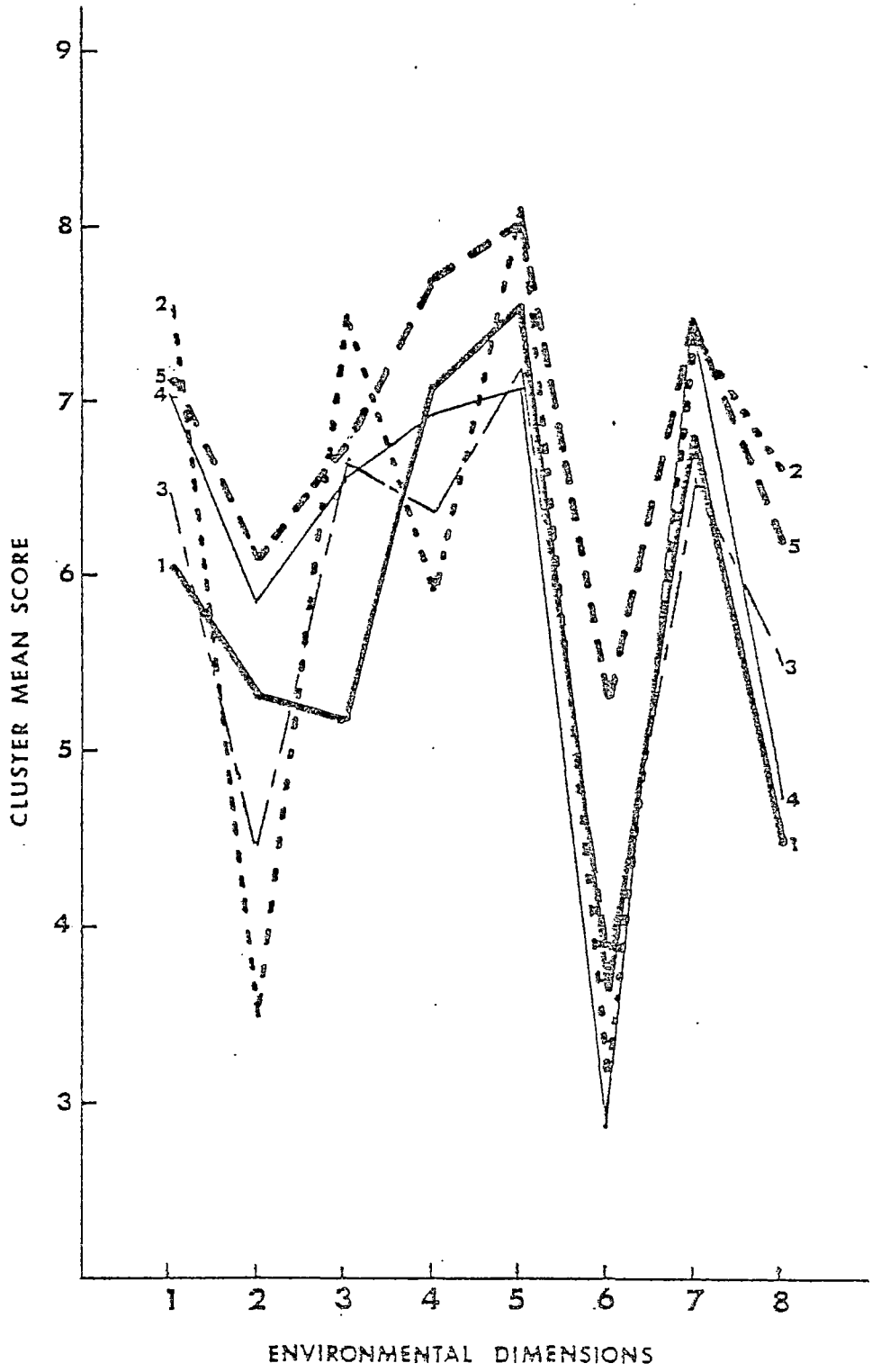

Figure 2. Mean scores of environmental types on environmental dimensions.

Type 4--This group scores higher on developed opportunities and lower on man's activities than any of the other groups. In addition, they score above average on commercial facilities and forests and meadows.

Type 5--This group is less concerned by man's activities than the other groups, they score higher on it. They also score above average on developed opportunities.

Demand Analysis

Method: The disaggregate travel cost method was used to estimate the demand for and values of trout fishing trips to the Reservation (Martin and Gum 1975). The dependent (quantity) variable used was the number of trips taken to the Reservation during the primary season, May 1 to September 30, 1977.

Trips are the recommended quantity variable when the travel cost method is used to estimate recreation demand (Dwyer, Kelly, and Bowes 1976). An alternative is days of use per season. Days would be a relevant variable to the Department of Natural Resources and Wildlife because they market days of fishing. However, in this study, the estimate of trips taken by the population sampled, adjusted based on the data collected from the sample of nonrespondents, is considered to be less biased than the estimate of total days fished. This conclusion is based on the assumption that the respondents were not only more active in terms of number of trips, but also in terms of trip duration, than the nonrespondents.

The main problem presented by nonresponse bias in the estimates of total trips and/or days of fishing is in their use to calculate expansion factors to blow up the sample estimates to the population. A biased dependent variable doesn't effect the estimates of the regression coefficients provided the independent variables are measured without error (Hu 1973).

In calculating the consumers' surplus value using the disaggregate approach, only the coefficient(s) on the price variable(s) is used, not the intercept. Predicted number of trips at posited added costs and consumers' surplus are calculated for each party given their number of actual trips taken at zero added cost , and aggretated over respondents. Thus, the intercept does not enter directly. Because an estimate of the bias in the number of trips was made and used to adjust the estimate of mean trips, it is assumed that most of the bias has been removed. This is predicated on the further assumption of no bias in the estimates of the price variable and other independent variables. Comparisons of the characteristics of respondents and nonrespondents shown above lend support to this last assumption.

It has been pointed out that permits were sampled and that they represent trips. The trips were taken by parties, 81 percent of which were families and families and friends. Because decisions to take trips are made by parties, the dependent variable was trips per party.

Travel costs per party trip were used as the price surrogate. These data were gathered for the party's most recent trip. The assumption is that the most recent trip represented a typical trip for that party. Automobile transportation costs were calculated based on the round trip distance from the respondent's home to the Reservation site visited. These mileages were measured from a map. Costs of food and lodging while traveling to and from the Reservation were asked for in the questionnaire. An estimate of food costs over and above those that would have been incurred if the party had stayed home was derived. The method of calculation of travel costs is shown in Appendix A.

Other independent variables that were examined included the respondent's family income, education, age, psychological outcome type, and travel time. Income was examined for obvious reasons. Age and education may be considered proxies for tastes and preferences as well as measures of physical capability and knowledge of recreation alternatives.

The psychological outcome types were examined because it was hypothesized that they were measures of preferences and/or descriptive of the kinds of recreation experiences obtained by the respondents (Driver and Brown 1978). The hypothesis was that different fishermen/experience types would have different demand functions for fishing on the Reservation (King 1979).

This hypothesis was tested by entering the psychological outcome types as dummy variables and testing for differences in intercepts and slopes; these tests were made using an approach suggested by Ben-David and Tomek.

As stated above, a modification of the regional model of Burt and Brewer (1971) was to be used in estimating demand. Because of the small sample size, it was not possible to estimate separate demand functions for each fishing site on the Reservation. Therefore, three groups of fishing sites were defined on the basis of type of water and geographical clustering. An attempt was made to estimate demand equations for each group including not only travel costs to the given group of sites, but also travel costs to the other two groups to account for substitution effects. Statistically reliable equations could not be estimated, and the approach was abandoned. Instead the Reservation was taken as a single "site", and the demand for it was estimated. No provision for

substitution effects was included in the analysis presented here. Further analysis is planned in which travel costs for these fishermen to at least two alternative areas will be included to account for substitution effects.

Travel time was used to account for, in a very simple way, the value of time. A more sophisticated approach, using some aspects of a suggestion by McConnell (1975), was planned. It was abandoned because the necessary data could not be gathered via a mail survey.

Analysis: The regression analysis proceeded in several stages. First, all of the independent variables except the psychological types were explored using stepwise regression. Only the regression coefficients on age and travel cost were significantly different from zero at the 10 percent level. For simplicity, only linear functional forms were used. This equation is shown as equation 1 in Table 21.

Next, the dummy variables for the psychological outcome types were entered in to the analysis by themselves and as terms in interaction with travel cost, along with cost and age. Thus, they were allowed to show influences on both the intercept and the slope of the function. An alternative approach would have been to estimate separate equations for each psychological outcome type. That approach was not used because of low degrees of freedom and its higher cost. All eleven psychological outcome dummy variables were used because the unclassified fishermen made up a twelfth type, and hence, no matrix inversion problems existed.

The tests for differences in slopes, intercepts, and both slopes and intercepts are presented in Appendix B.

The general model at this stage was:

$$Q = a_o + \sum_{i=1}^{11} a_i D_i + b_o C + \sum_{i=1}^{11} b_i D_i C + f_o A$$

Table 21. Alternative Statistical Demand Equations Estimated

. uation	Variables[a]																								AdjR^2	F
	a	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	D_9	D_{10}	D_{11}	C	D_1C	D_2C	D_3C	D_4C	D_5C	D_6C	D_7C	D_8C	D_9C	$D_{10}C$	$D_{11}C$	A		
1	2.287 (3.236)												-.026 (3.839)												-.047 (3.215)	.033	12.43 (2,24
2	1.539 (1.309)	-1.946 (1.452)	-5.209 (2.340)	-2.280	-3.545 (.479)	-1.985 (1.144)	-2.752 (1.306)	-3.156 (1.670)	2.802 (1.795)	5.555 (2.989)	-3.452 (1.933)	-2.076 (1.282)	-.072 (2.671)	-.064 (2.220)	.081 (1.003)	.045 (1.346)	.054 (.290)	.053 (1.027)	.047 (1.233)	.041 (1.020)	.059 (1.233)	-.144 (3.131)	.057 (1.430)	.050 (1.552)	-.046 (3.170)	.17206	3.173 (24,2
3	2.708 (3.378)	-.291 (.278)	-3.524 (1.800)	-1.138 (.938)				-1.451 (.906)	1.685 (.943)	7.245 (4.621)	-1.770 (1.195)		-.034 (2.941)	.027 (1.700)	.044 (1.263)	.076 (.334)				.003 (.104)	.022 (.536)	-.182 (4.688)	.019 (.600)		-.051 (3.574)	.18452	4.550
4	2.051 (2.912)	.321 (.320)	-2.956 (1.525)							7.874 (5.200)			-.030 (3.475)	.023 (1.640)	.040 (1.181)							-.187 (4.915)			-.051 (3.701)	.19437	8.560 (4,24
5	1.976 (2.800)	.469 (.470)								8.005 (5.290)			-.028 (3.389)	.021 (1.529)								-.188 (4.961)			-.049 (3.595)	.19294	11.00 (6,24
6	2.037 (2.959)									7.926 (5.270)			-.030 (3.785)	.025 (2.406)								-.187 (4.948)			-.050 (3.648)	.19549	13.19 (5,24

a. t-values for the regression coefficient shown in parentheses

b. degrees of freedom shown in parentheses

Where: Q = number of trips per party

D_i = dummy variable for psychological outcome type, i = 1...11.

e.g.: D_1 = 1 if party respondent was included in psychological outcome type 1,
= 0, otherwise.

C = variable costs of travel

D_iC = interaction term

A = age of respondent

With all eleven outcome types entered into the regression analysis, statistically significant differences at the 5 percent level were shown for slopes, intercepts, and both slopes and intercepts. The adjusted R^2 was .17 and its F value was significant at less than the 1 percent level. The equation is shown in Table 21. Many of the individual regression coefficients, however, were not statistically different from zero at the 10 percent level. Because the primary interest was in specification of demand and the reliability of the cost coefficient, dummy variables and interaction variables were selected from among the 22 such variables for further analysis. Those variables with coefficients signficant at 10 percent were chosen with the additional condition that the selection include both the additive form and the interaction form even though only one of the two had a significant coefficient.

This selection resulted in the following equation:

$$Q = a_o + \sum_{i=1}^{3} a_i D_i + \sum_{i=7}^{10} a_i D_i + b_o C + \sum_{i=1}^{3} b_i C + \sum_{i=7}^{10} b_i C + f_o A$$

The estimates and statistics for this equation are also shown in Table 21. Again all tests for slope and intercept differences showed significant difference at the 5 percent level, and the overall equation was statistically significant. It should be noted here that the successive test of hypotheses engaged in violate the assumption of the independence of the tests. However,

the purpose in using them is to guide the development of the model. Ideally, the model finally settled upon should be tested with data from another sample of fishermen. Unhappily, that luxury is not available, and the sample size was not large enough to allow model development with a subsample and estimation with the remaining portion of the sample.

Once again, however, some of the individual coefficients were not significantly different from zero at the 10 percent level. The same process of variable selection was used to arrive at the following equation:

$$Q = a_o + a_1D_1 + a_9D_9 + b_oC + b_1D_1C + b_9D_9C + f_oA$$

Again, all tests for slope, intercept, and both slope and intercept differences were significant, and some coefficients were not significantly different from zero. (see Table 21). Applying the variable selection process once more led to the following model:

$$Q = a_o + a_1D_1 + a_9D_9 + b_oC + b_1D_1C + b_9D_9C + f_oA$$

As expected, the tests for slope, intercept, and both slope slope and intercept differences were significant. The regression coefficient of D_1, however, was not significant and a final demand equation was estimated.

$$Q = a_o + a_9D_9 + b_oC + b_1D_1C + b_9D_9C\ f_oA$$

The statistical reliability of the cost coefficient (C) is slightly lower in equation six than in equation one. It is quite stable (little change in its value) across equations four through six.

The coefficient on age (A) is remarkably stable across all six equations.

From equations three through six, the D_9 coefficient is very stable and has a high degree of reliability (as measured by its t-value).

The coefficients on the two interaction terms (D_1C and D_9C) are relatively stable from equations three through six.

Inclusion of the psychological variables improves the overall goodness of fit, the adjusted R^2 values for the equations including psychological variables are all at least twice the adjusted R^2 of equation one.

In an overall sense, all of the equations are statistically significant.

This final demand equation implies three separate demand equations, one for each of three market segments as follows:

Psychological Type 1:

$$Q = 2.037 - .005C + .050A$$

Psychological Type 9:

$$Q = 9.936 - .217C + .050A$$

All other fishermen:

$$Q = 2.037 - .030C + .050A$$

The specification without the psychological variables (Table 21, equation 1) is: $Q = 2.287 - .026C - .047A$

This specification results in a cost coefficient most nearly that of the equation for all other fishermen. Such a result is to be expected because that group is a high proportion of the sample. The other two demand equations, however, have cost coefficients very much different from that of the specification without the psychological variables.

The three demand equations indicate vastly different elasticities of demand. These elasticities, calculated at the point of mean trips and travel cost for eacy type, are:

Type 1 e = -.0518
Type 9 e = -1.4278
All Other e = -.4239

Price elasticity of demand is a measure of the responsiveness of consumers to price changes. Type 1 fishermen have a very inelastic demand, a 1 percent change in price would result in a .05 percent change in trips taken. They are not very responsive to price. Type 9 fishermen, on the other hand, are the most responsive of the three types of fishermen; a 1 percent change in cost resulting in a 1.4 percent change in trips taken. Fishermen in the Other category also have an inelastic demand for fishing trips, but it is more elastic than the demand of the Type 1 fishermen.

The Other category of fishermen make up the bulk of the sample and the population, 84 percent. So for the majority of Reservation fishermen, demand is inelastic. This result agrees with the findings from examining the responses that have occurred in permit purchases following fee increases.

The elasticity at the point of means for the total sample for the demand specification that did not include psychological variables is:

$$e = -.3426$$

Because the point elasticity of demand varies from point to point on the demand curve, it is useful to compare the elasticities of these demand functions at the same point, and the point of means of trips and cost per trip for the total sample was chosen for the following comparison.

The elasticity estimate for the specification without psychological variables is shown above. For the other three demand equations the estimates are:

Type 1	$e = -.0580$
Type 9	$e = -2.8590$
All other	$e = -.3887$

The elasticity of the demand for a good or service depends upon the suitability and availability of substitutes, income, and preferences. Because of the limited geographical scope of the Reservation market, the

fishermen all tend to face essentially the same substitution situation. Generally, the greater the substitution possibilities, the more elastic is the demand for a good or service. Thus, differences in substitution possibilities do not seem to be an explanation for the very elastic demand of the Type 9 fishermen. The question then, is, are there differences among these three market segments that appear to be related to differences in preferences and/or income. The stronger the preference for a good or service the more inelastic is the demand, other things being equal. And people with high incomes tend to be less concerned with costs than people with lower incomes, leading to inelastic demand.

In Table 22, the mean scores of the three market segments on each of the psychological dimensions are presented along with the rank of the dimension based on the mean scores. The scores for the Other category are the weighted mean scores of the fishermen types included within it.

Type 1 fishermen score lower than the other two types on all dimensions. Since their demand is most inelastic, the expectation was that they would have higher mean scores on the dimensions; they would generally receive more satisfaction. Further, it would be expected that the Type 1 and the Other category would be more like each other, in terms of means scores, than like Type 9 fishermen, and that is not the case.

One might speculate that there is some untapped psychological dimension that provides Type 1 fishermen with a large amount of satisfaction. However, the research that led to the development of the individual psychological scale items was very exhaustive (Driver 1977) and such a possibility seems unlikely.

In looking at other characteristics of the fishermen, (Table 23), significant differences among psychological outcome types, at the 10 percent

Table 22. Ranks by psychological outcome types by scores on five psychological dimensions.

Psychological Outcome Type	Psychological Dimensions				
	Self Development	Using Skills and Equipment	Rest Relaxation	Being with Friends	Scenic Beauty
1 n=33	3 (5.91)	3 (6.12)	3 (6.60)	3 (6.56)	3 (7.53)
9 n=25	2 (6.42)	1 (7.32)	1.5 (7.66)	1 (7.85)	2 (8.00)
Other* n=261	1 (6.49)	2 (6.83)	1.5 (7.65)	2 (7.28)	1 (8.29)

* Does not include unclassified fishermen.

Table 23. Means and distributions of some characteristics of fishermen types on the Fort Apache Indian Reservation, 1978.

Fisherman Type	Age** (years)	Size of Party** (persons)	Education (years)	Income* ($)	Trout Fishing on Reservation (years)
		Characteristics			
1	48.0	3.1	15.2	30,625	9.5
9	40.8	4.0	13.7	19,500	12.1
Other	40.8	4.5	13.5	24,897	12.0
Total Sample	41.0	4.2	13.7	25,174	11.8

Fisherman Type	Trout* Fishing	Type of Fishing		
	Anywhere (years)	Fly (%)	Lure (%)	Bait (%)
1	24.0	23	23	54
9	19.2	12	6	82
Other	17.1	14	15	71
Total Sample	18.1	15	15	70

* Differences among means significant at 10% level.
** Differences among means significant at 5% level.

level, were shown for age, number of persons in the party, income, and years of fishing. Type 1 fishermen were the oldest and their parties the smallest. An S-N-K multiple range test, however, showed significant differences in mean age only between Type 1 and Type 4 fishermen and in mean party size, only between Type 1 and Type 4 fishermen and in mean party size, only between Type 1 and Type 7 fishermen. Type 9 fishermen fall near the middle of the ranges of these two means.

Type 9 fishermen have the lowest mean income. This tends to support their elastic demand. Of the 11 types of fishermen, Type 1 fishermen have the second highest mean income, which supports the finding of an inelastic demand for them.

The Type 1 fishermen have the highest mean years of trout fishing but lowest mean years of fishing in the Reservation. Furthermore, the ratio of their years of Reservation fishing to years of fishing anywhere is much smaller than for the remainder of the sample.

A higher proportion of fly and lure fishermen was found among Type 1 fishermen than the rest of the sample. Type 9 fishermen, on the other hand, include a higher proportion of bait fishermen than does the total sample.

The picture that emerges of the Type 1 fisherman is one of an older, highly experienced, fly and lure, well-educated fisherman with an income in excess of $30,000 who receives less satisfaction from the psychological dimensions than other fishermen on the Reservation. This picture generally supports their inelastic demand.

The lower scores of the Type 1 fishermen on the psychological dimensions, given their other characteristics and inelastic demand, are difficult to explain. Their inelastic demand indicates a strong preference for

fishing on the Reservation while their low scores, relative to other fishermen, indicates the opposite. It was mentioned above that perhaps the psychological dimensions were incomplete, and it could be that Type 1 fishermen are receiving a high level of satisfaction from an untapped dimension. Another possible explanation might be that the Type 1 fishermen is a "worldly" fisherman, as evidenced by their experience, education, and age, and the Reservation fishing opportunities are less productive of these psychological sources of satisfaction for them than other sport fisheries they have used. In other words their standards are different than those of the other fishermen, but they love to fish, almost anywhere. It must be recalled that the psychological scale items were presented to the respondents in the very specific context of fishing trips on the Reservation.

Estimates of Market Demand Schedules and of Consumers' Surplus: Consumers' surplus is a measure of the value of the fishing trips over and above the costs of the trips to the fishermen. An excellent and straightforward presentation of the concept of consumers' surplus may be found in Martin, Gum and Smith (1974). They also demonstrate its method of calculation using the disaggregate travel cost method.

The calculation involves estimating the number of trips that would be taken by each party at increased costs. In this case, since there is now no entry fee to the Reservation as distinct from the daily fishing fee, such increased costs may be viewed as fees for entry. As costs are increased, the number of trips taken will decrease. A demand schedule of predicted number of trips at varying levels of additional cost is derived for each party in the sample. This is done by taking the actual number of trips taken and subtracting the change in trips that is predicted based on

the estimated per party demand functions. In this process, neither the intercept nor the age coefficient is used because the estimates are made for each individual party and their "intercept" is their actual number of trips, and their "age" is the age of the responding members of the party. Only the cost regression coefficient is used. The calculation may be shown as follows:

$T_1 = T_o - \Delta T$

Where: T_1 = predicted (new) trips

T_o = actual trips

ΔT = change in trips

and: $\Delta T = T_o - T_1$

$T_o = a - bC$

$T_1 = a - b(C + \Delta C)$

Where: a = intercept of demand function

b = cost coefficient

C = actual cost

ΔC = posited increment in cost

$\Delta T = (a - bC) - [a - b(C + \Delta C)]$

$= a - bC - (a - bC - b\Delta C)$

$= a - bC - a + bC + b\Delta C$

$= b\Delta C$

Therefore:

$T_1 = T_o - b\Delta C$

Using Figure 3, the calculation of a party's consumer surplus can be demonstrated. The intersection of the two axes is at 0 trips and 0 added cost. An added cost, C_1, is posited (C_1 minus actual cost equals ΔC) and the new number of trips is predicted as shown above, T_1 . Because the party

does not pay C_i per trip, it receives value greater than the costs it does pay. The party's consumer surplus resulting from not having to pay C_1 is the area OC_1dT_o. If the ΔC is small, an approximation is $(\Delta C)(T_1)$, the area OC_1dT_1. By repeating this process and summing the consumer's surplus of successive cost increments, the area under the party's demand can be approximated, their total consumer's surplus. Mathematically:

$$C.S. = \sum_{i=1}^{n} \Delta C T_i$$

where: T_i = predicted trips at each of i cost increments.

If the cost increments are constant,

$$\Delta C = K$$

and,

$$C.S. = K \sum_{i=1}^{n} T_i$$

and further, if K = 1, then

$$C.S. = \sum_{i=1}^{n} T_i \text{ in dollars.}$$

Summing the individual party consumer's surplus gives total consumers' surplus. This is then expanded by the appropriate expansion factor to arrive at an estimate of total consumers' surplus for the given type of fishermen.

The computer program has the capacity to calculate predicted trips, and total revenue for up to 2,000 increments. One dollar increments were used and the number of increments was constrained so the maximum added cost would be equal to the maximum actual travel cost incurred. This was done even though the number of predicted trips did not decrease to zero at that level of added cost. The constraint was imposed to avoid making predictions beyond the range of the cost data used to estimate the party demand equations. Hence, the population demand schedules

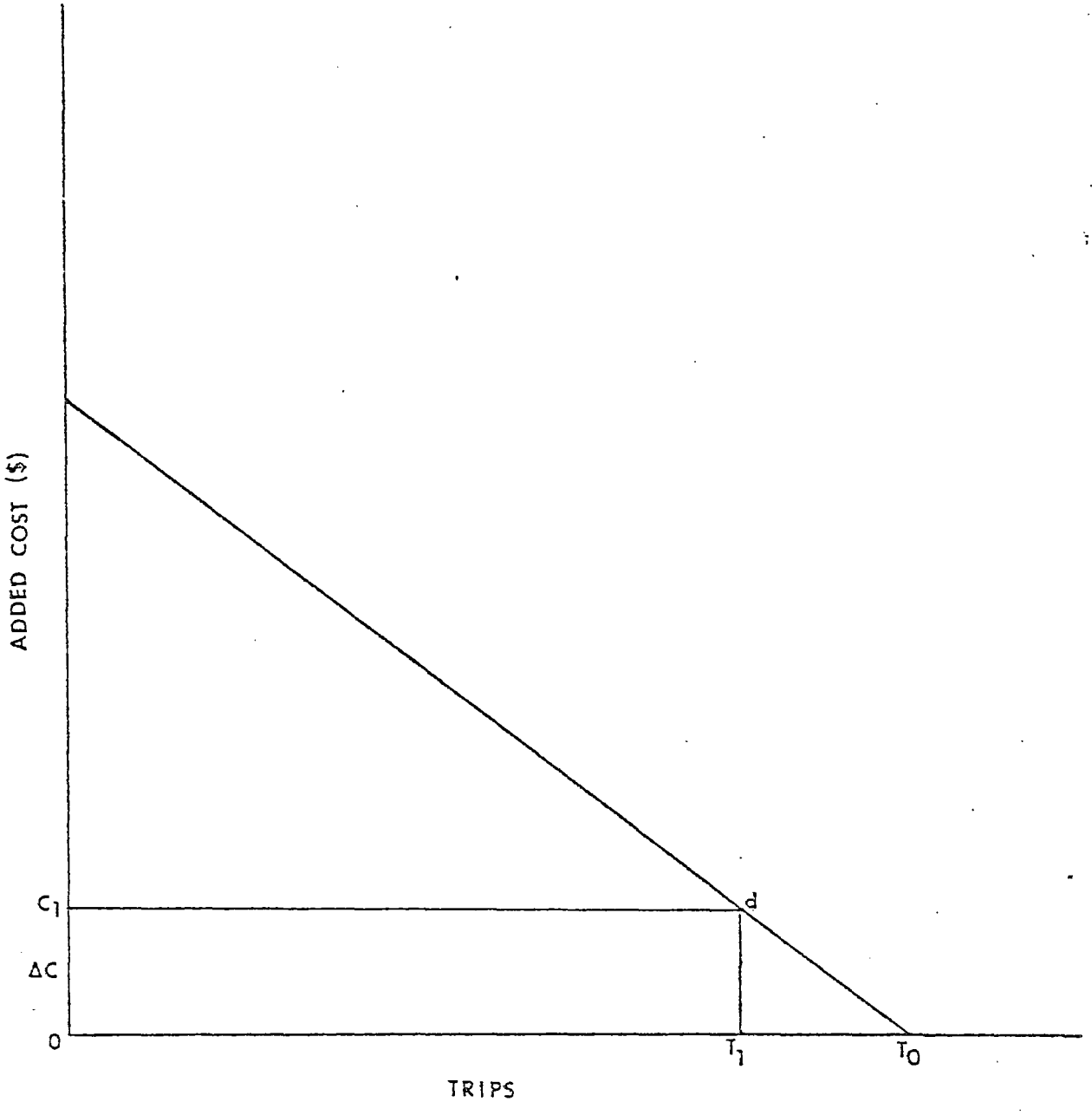

Figure 3. Calculation of consumer's surplus.

are truncated at an added cost equal to the highest cost incurred by any individual party in the given fishermen type. The implicit assumption is that the party incurring the highest cost would stop making trips entirely if trips cost one dollar more. The consumers' surplus estimates are lower than they would have been if this constraint had not been imposed.

The demand schedules for each of the market segments are presented in Tables 24, 25, and 26 , and the aggregation of the three segments into an overall demand schedule is presented in Table 27. The added costs may be viewed as potential entry fees to the Reservation. The entry fees that would maximize total revenues are indicated with an asterisk. The added cost increments are shown in 5 or 10 dollar increments to conserve space. The revenue maximizing added cost level may actually fall somewhat above or below the levels indicated.

Estimates of consumers' surplus are shown in Table 28. As would be expected from the estimates of demand elasticity for the three market segments, Type 1 fishermen have the highest average consumers' surplus and revenue maximizing entry fee followed by the Other fishermen and Type 9 fishermen.

The consumers' surplus estimates, it should be noted, are estimates of the net benefits received by the fishermen. They do not represent revenue that the Tribe could obtain from fishermen.

The effect of segmenting the market on the estimates of consumers' surplus can be shown by comparing estimates made with and without segmentation. Using the cost coefficient from equation 1, no segmentation, consumers' surplus was estimated for each of the three groups of fishermen (Table 29). In comparing these estimates with those shown in Table 28, it can be seen that the overall effect of segmentation is a larger estimate

of consumers' surplus. The quite elastic demand of the Type 9 fishermen is not accounted for when the market is not segmented. Hence, the non-segmented approach results in higher estimates of their consumers' surplus than those calculated using the segmented approach. The opposite occurs for the Type 1 fishermen because their demand is very inelastic in comparison to the rest of the sample. The Other group has demand just slightly more inelastic than the whole sample, so the estimate of their consumers' suprlus without segmentation is slightly higher than with segmentation.

Table 24. Reservation demand schedule of type 1 fishermen.

Added Cost $	Number of Trips	Total Revenue
0	3,330	0
10	3,114	31,140
20	3,083	61,660
30	8,052	91,560
40	3,021	120,840
50	2,990	149,500
60	2,960	177,600
70	2,929	205,030
80	2,898	231,840
90	2,867	258,030
100	2,836	283,600
110	2,805	308,500
120	2,775	333,000
130	2,745	356,800
140	2,713	379,820
150	2,682	402,300
160	2,651	424,160
170	2,620	445.400
180	2,590	466,200
190	2,590	492,100
200	2,559	511,800
220	2,497	549,340
240	2,436	584,640
260	2,405	625,300
280	2,373	688,460
300	2,343	702,900
320*	2,281	729,920

*"Price" level which maximizes gross revenue

Table 25. Reservation demand schedule of type 9 fishermen

Added Cost $	Number of Trips	Total Revenue
0	2,020	0
5	1,636	8,180
10	1,371	13,710
15	1,155	17,325
20	1,034	20,680
25	914	22,850
30	818	24,450
35	722	25,220
40	674	26,960
45	602	27,090
50	553	27,650
55*	505	27,775
60	457	27,420
65	409	26,585
70	361	25,270
75	337	25,275
80	313	25,040
85	289	24,565
90	265	23,850

*"Price" which maximizes total revenue

Table 26. Reservation demand schedule of type 2-8, 10, 11, and unclassified fishermen.

Added Costs $	Number of Trips	Total Revenue $
0	14,376	0
10	12,552	125,520
20	11,279	225,580
30	10,028	226,626
40	8,902	259,292
50	8.118	405,900
60	7,231	433,860
70	6,413	448,910
80	5,844	467,520
90*	5,253	472,770
100	4,662	466,200
110	4,275	470,250
120	3,934	472,000
130	3,593	467,090
140	3,274	458,360
150	3,002	450,300
160	2,751	440,160
170	2,501	425,170
180	2,342	421,450
190	2,206	419,140
200	2,047	409,400
210	1,932	405,720
215	1,887	405,705

*"Price" which maximizes total revenue

Table 27. Total demand schedule for Reservation[1/]

Added Cost $	Number of Trips	Total Revenue $
0	19,726	0
10	17,037	170,370
20	15,396	307,920
30	13,598	416,940
40	12,821	412,840
50	11,661	583,050
60	10,648	638,880
70	9,703	679,210
80	9,055	724,400
90	8,385	754,650
100	7,498	479,800
110	7,080	778,800
120	6,709	805,080
130	6,338	823,940
140	5,987	838,180
150	5,684	852,600
160	5,402	864,320
170	5,121	870,570
180	4,932	887,760
190	4,796	912,240
200*	4,606	921,200
220	2,497	549,340
240	2,436	584,640
260	2,405	625,800
280	2,373	688,460
300	2,343	702,900
320	2,281	729,920

1/ Calculated by horizontal summation of the three demand schedules, Tables 24-26.

* "Price" which maximizes total revenue.

Table 28. Consumers' surplus values for trout fishing on the Fort Apache Indian Reservation by fishermen type, 1978.

Fishermen Type	Consumers' Surplus	Associated Trips	Average Consumer Surplus per trip
1	$ 875,972	3,330	$263
9	65,685	2,020	32
All other	1,184,367	14,376	82
Total	2,126,024	19,726	108

Table 29. Consumers' surplus estimates based on a single demand equation.

Fishermen Type	Consumers' Surplus	Associated Trips	Consumers' Surplus per trip
	$		$
1	521,849	3,330	156.71
9	156,800	2,020	77.62
All other	1,289,225	14,376	89.68
Total	1,967,874	19,726	99.76

Comparisons with Another Estimate: In 1970, Martin, et. al. (1974) estimated the consumers' surplus value of cold water fishing in Arizona Game and Fish Region 1, which included the Reservation. If their estimate is updated to 1978 dollars, using the percent change in the Consumer Price Index, and allocated to the Reservation based on areal proportion[5/], an estimate of $4,953,060 is obtained, 233 percent of the $2,126,024 estimated in this study. If the average consumers' surplus per trip estimated by Martin, et. al. (1974) is updated to 1978 dollars, the result is $126 per trip compared to $108 per trip estimated in this study.

Since travel costs have inflated more rapidly than the general price level over the time period in question, still another approach was used for comparative purposes. The cost coefficients of the coldwater fishing demand equation estimated by Martin, et. al. (1974) were used with the data of this study to estimate consumers' surplus. The result was $1,027,883 or 48 percent of the estimate of this study.

There is no way to explain the differences in estimates in either direction, with available information, because of the large number of potential sources of them. Some of these could be: Differences in survey design; differences in demand specification; changes in the structure of demand over time; difference in definition of the resource, a region versus a more specific portion of it; and validity of using changes in Consumer Price Index to update the value of a specific service.

Some satisfaction is derived from the fact that the estimate from this study lies between the two estimates made from the previous study.

[5/] Since their study was done, the regions have been redefined and reduced in number. Region 1 has been enlarged. The calculation was based on the 1970 delineation of Region 1.

CONCLUSIONS

Methodological

The use of psychological variables to improve the specification of demand was the methodological objective of interest in this study. The psychological outcome scales were used to arrive at three market segments with a demand equation for each. The statistical analyses indicate an improved specification of demand with segmentation when compared to simply using cost and age. The tests for interactions were all significant at the 5 percent level. While the reliability of the cost coefficient, taken by itself, did not increase, the statistical tests for differences in it among the three market segments were positive.

If three segments based on fishermen psychological types improved demand specification, why not 11 segments, one for each fishermen type? A larger sample might have resulted in greater segmentation. Another factor to consider is that the reliability coefficients on the psycological dimensions were all less than the desirable value of .9. In other words, the dimensions upon which the eleven psychological types were defined did not have the degree of internal consistency considered desirable. Thus, the definition of the fisherman types may not be sufficiently reliable or consistent to support further segmentation.

The cluster analysis based on the psychological scales provided an initial segmentation of the market in terms of fishermen types. The regression analysis then provided for further refinement and a reduction of market segments from eleven to three. The quite different demand elasticities of the three market segments and the other differences among the three fishermen segments support the conclusion that at least three market segments do exist.

Management

Native Trout Fishing Alternatives: The results indicate that the idea of providing special opportunities to fish for the native Arizona trout is viable enough to try. Of the six alternatives, the one with the largest prospective revenue is Alternative D, an opportunity providing a three-day experience with full outfitting, access by horse, and catch and keep fishing. The predicted number of fishermen days is approximately 3,960. Generally, the catch and release alternatives were viewed less favorably than the alternatives with a catch and keep limit.

The results support the trial of at least one of the alternatives. Before selecting the trial alternative, analysis of the costs of each should be made to determine the alternative with the largest potential net revenue. Any trial should be carefully monitored to provide information to evaluate its performance. The effects of fishing on the fish population should also be taken into consideration.

Preferences for Environmental Attributes: The relatively strong and general dissatisfaction produced by evidence of logging and mining activity dimension coupled with the strong and general satisfaction produced by the forest and meadow dimension is an important finding. Simply providing fish is not enough. A pleasing aesthetic environment may be more important than a high fishing success ratio in holding the market the Reservation has now. This conclusion is further supported by the very strong contribution to satisfaction of the natural beauty psychological dimension.

The reaction to the presence of commercial facilities at fishing sites was mixed. For some fishermen these faciltiies were a source of satisfaction, for some unimportant, and for others a source of dissatisfaction.

The weak contribution of fishing enhancement features to satisfaction, among a group of fishermen, may seem surprising. It follows, however,

from several characteristics of the fishing opportunities and the kinds of fishermen they attract. Most of the fishing takes place at artificial lakes that do not support natural reproduction and is a put and take operation. This type of fishing primarily attracts bait, not fly, fishermen. Further, it is not affected by the fishing enhancement features included in that environmental dimension. The relatively low scores on that dimension compared to those on the forest and meadow environmental dimension and the scenic beauty psychological dimension leads to a conclusion that fishing is not an overriding motive for visits to the Reservation by fishermen. This, of course, supports the general concept of the recreation experience as being a bundle of psychological outcomes. Providing a high fishing success ratio is not enough, by itself, to hold or expand the recreational market of the Reservation. This conclusion does not deny the importance of the success ratio, especially among what might be termed "casual" fishermen who appear to make up the bulk of the present fishermen population using the Reservation. It, in fact, may be more important to that type of fishermen than to the "expert" fishermen.

Demand and Market Segmentation: The results indicate that, in general, the demand for fishing on the Reservation is inelastic. This finding is in agreement with those of other recreation demand studies. It must be noted that the effect of substitutes was not provided for in the demand specification . The inclusion of substitution variables would be expected to increase the estimated elasticity. Hence, further analysis will be done taking substitutes into account.

An inelastic demand implies a strong demand in the sense of strong preferences and/or a perceived lack of suitable substitute fishing opportunities. These implications, however, should not be taken as justification

for taking a relaxed attitude toward providing quality fishing opportunities or for ignoring the potential effects of fee increases. At some fee level demand does become elastic and further fee increases would result in a decrease in total revenue. Although no questions were asked about specific campground and sanitation facilities, voluntary comments by the respondents indicated that the fee increases that had occurred were acceptable, but that further increases should be accompanied by observable improvement in the quality of campground and sanitation facilities.

There is a small segment of the market, the Type 1 fishermen, that values trout fishing on the Reservation quite highly and that appears to be definable as being made up of purists in terms of experience and fishing sytle. The fishermen in this segment are also highly educated and have high incomes. While they represent only 9 percent of the fishermen population, their consumers' surplus is 41 percent of the total. This segment of the market, if more specifically provided for, could be tapped for additional revenue and possibly expanded.

Management Recomendations

1. Native Trout Fishing: A limited trial of a special native trout fishing opportunity should be made. A hike-in, day use opportunity would be the simplest trial opportunity. The provision of such an opportunity would be easy if it were limited geographically and operational costs of such an alternative would be lower than for the other alternatives. A higher gross revenue could be obtained from alternatives involving full outfitting, but the costs would also be higher. These costs should be estimated to determine the potential net revenues that might be gained. This recommendation assumes the biological feasibility of providing such opportuniities. Any trial should be carefully monitored.

2. A Different Kind of Fishing Opportunity: More primitive, restricted fishing opportunities should be provided. A potential exists to tap a segment of the market for additional revenue by catering to the preferences of the fishermen in that segment. On a trial basis, a stretch of stream could be set aside for fly only fishing at a fee higher than, perhaps double, the ordinary fee. The stretch could have auto access at either end, but it should have none at intermediate points.

3. Conflicts With Other Resource Uses: The Department of Natural Resources and Wildlife should work with the Timber Management Department to minimize the potential conflict between fishermen and logging activities. The findings of this study provide a basis for demonstrating that adverse affects on camping and fishing revenues could result from practices that make logging activities highly visible.

4. Design and Location of Facilities: All facilities should be designed to be compatible with the natural environment. Commercial and camping facilities should be located so as not to impact, visually or physically/biologically, on the fishing opportunities. Not every fishing site should have commercial faciltiies nor should every site be without them. No recommendation can be made, based on this study, as to the optimal allocation of commercial facilities to sites.

5. Management of the Natural Environment: The immediate environments of the fishing and camping sites should be managed to maintain or improve their natural, aesthetic qualities. The importance of the natural beauty psychological dimension and the forest and meadow environmental dimension to the satisfaction of the recreational visitor is the basis for this recommendation.

6. Campground Improvement and Maintenance: The quality of campground and sanitation facilities and the maintenance of them should be improved.

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Appendix A

Calculation of Travel Costs

Travel costs were defined as transportation, food, and lodging costs incurred while traveling to and from the fishing site. Only food costs over and above those that would have been incurred if the party had stayed home were relevent. Estimating this figure required an estimate of "normal" food costs.

1. Normal food costs: Food costs for those parties who said these were the same as if they had stayed home were regressed against miles traveled. The resulting equation was used to predict normal food costs for those parties who said they had spent more than if they had stayed home.

2. Travel food costs: If the party reported expenditures on food less than or equal to what they would have spent at home, their travel food costs were set equal to zero.

If the party reported spending more on food while traveling than if they had stayed home, their normal food costs were estimated using the regression equation described above. Then their predicted normal food costs were subtracted from their reported food costs to arrive at an estimate of their additional food costs while traveling.

3. Nontransportation costs: These were defined as the sum of the travel food costs, as estimated above, and costs of lodging while traveling to and from the Reservation. This sum was calculated for each party.

4. Nontransportation costs as function of miles: Because the costs for the last trip were taken as representative of costs of any other trips to the same fishing site and respondents' trips in the previous year's season (the quantity variable in the demand analysis) could have been to any of the other sites, it was necessary to estimate costs for any site the party may have visited the previous season. For this reason, nontransportation costs were regressed against miles to obtain an equation with which to estimate nontransportation costs to any site based on roundtrip mileage.

5. Transportation costs: Average variable automobile operating costs per mile in 1976* were:

Repairs	$0.0367
Tires	0.0045
Gas	0.0406
Oil	0.0017

The costs of tires, repairs, and oil were updated to 1978 using the percent change in the Consumers Price Index. The result was $0.0482 per mile.

The cost of gasoline was updated using a 1978 price for regular gasoline and, as was done for the DOT estimates for 1976, assuming 15 miles per gallon of gasoline. The estimate of the 1978 gasoline costs was $0.0438 per mile.

Gasoline costs per mile were added to the repair, tires, and oil costs per mile to arrive at a cost per mile of $0.092.

6. Travel costs per trip: The automobile costs per mile, $0.092, were added to the coefficient on miles of the equation estimated by regressing non-transportation costs against miles. This equation was then used to estimate travel costs per trip to any site a party may have visited in the previous season based on roundtrip mileage. This approach follows that of Burt and Brewer (1971).

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*Source: U.S. Department of Transportation, FHA, Cost of Operating an Automobile, 1976.

Appendix B

Tests for Interaction

The method described by Ben-David and Tomek was used to test for differences in intercepts, slopes, and intercepts and slopes attributable to the psychological outcome types in the demand equation. That method is presented here.

Recall the general model:

$$(1) \quad Q = a_o + \sum_{i=1}^{11} a_i D_i + b_o C + \sum_{i=1}^{11} b_i D_i C + f_o A$$

When: i = psychological outcome type, i = 1...11

Q = number of party trips

C = travel cost per trip

A = age of respondent

D_1 = 1 when i=1, 0 otherwise

D_2 = 1 when i=2, 0 otherwise

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D_{11} = 1 when i=11, 0 otherwise

This equation was estimated and is shown as equation 2 in Table 21. As noted above, it could be estimated without dropping one of the dummy variables because some respondents could not be classified.

To test the three hypotheses with respect to slopes and intercepts, it is necessary to estimate three additional equations of the following forms:

$$(2) \quad Q = a_o + b_o C + \sum_{i=1}^{11} b_i D_i C = f_o A$$

$$(3) \quad Q = a_o + \sum_{i=1}^{11} a_i D_i + b_o C + f_o A$$

$$(4) \quad Q = a_o + b_o C + f_o A$$

Note that equation 2 assumes no difference in intercepts, allowing only for differences in slopes among psychological outcome types. Equation 3 assumes no differences in slopes, allowing only for differences in intercepts. Equation 4 assumes no differences in slopes or intercepts.

Let: SSR_i = sum of squares of residuals for equation i.

d.f.i = degrees of freedom for equation i.

To test for differences in intercepts, F is computed as follows:

$$F = \frac{SSR_2 - SSR_1}{SSR_1} \cdot \frac{d.f.1}{d.f.2 - d.f.1}$$

To test for differences in slopes, F is computed as:

$$F = \frac{SSR_3 - SSR_1}{SSR_1} \cdot \frac{d.f.1}{d.f.3 - d.f.1}$$

And, to test for differences in both intercepts and slopes, F is computed as:

$$F = \frac{SSR_4 - SSR_1}{SSR_1} \cdot \frac{d.f.1}{d.f.4 - d.f.1}$$